Space Weather Technical Forecast

Issued on Wednesday, 09 November 2022 at 12:48 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of isolated M-class flares (R1-R2/Minor to Moderate radio blackouts) throughout. Very slight chance of G1/Minor storms days 1 and 2 (9th and 10th).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low, with only a minor C-class flare observed at 08/1703 UTC, which originated from AR3141 located in the east. There are currently five numbered sunspot regions and one unnumbered group on the visible disc. AR3141 in the east remains the largest, most active and complex group, classified as Eko/Beta-gamma. AR3140 is the second largest region, with a moderately sized mature spot, Hsx/Alpha, though the region remains largely inactive. The only other moderately sized uni-polar spot remains AR3135, Hsx/Alpha in the far northwestern hemisphere. All other spots are small and relatively simple. No Earth-directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: The solar wind, observed by ACE/DSCOVR at L1, has been at background levels, with speeds mainly below 380km/s. Density was average to below average. Total magnetic field strength, IMF, has been predominantly weak. The north-south component, Bz was initially negative, with a peak value of -7nT at 08/1209 UTC. Over the period it has risen to become close to neutral. Phi angle has been mostly positive (away from the Sun), but with a brief period of negative polarity (towards the Sun) between 09/0830-1000 UTC. Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES-16 has remained at background levels. High energy electron flux (greater than 2 MeV) at GOES-16 was at background to moderate levels, with a peak of 365 pfu at 08/1700 UTC. Electron fluence levels are currently at background levels, with a slight upward trend to a peak value of 7.7e6 integrated pfu observed at 09-1200 UTC. The value of integrated pfu observed at 09/0001 UTC was 5.5e6.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to be Low, with a chance of isolated Moderate activity.

Solar Wind / Geomagnetic Activity: Geomagnetic activity is expected to be mainly Quiet to Unsettled given generally slow-ambient solar winds, but there is a chance of Active intervals at times given any prolonged periods of negative Bz and approaching coronal hole high speed streams. There is a very slight chance of G1/Minor Storm intervals, mainly due to the possible arrival of one or more coronal hole high speed streams, these most likely to arrive late on day 1 (9th) and into day 2 (10th). Becoming mostly Quiet to Unsettled on days 3 and 4 (11th and 12th) due to waning effects of coronal hole fast winds.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) observed by GOES-16 is expected to remain at background levels. High energy electron flux

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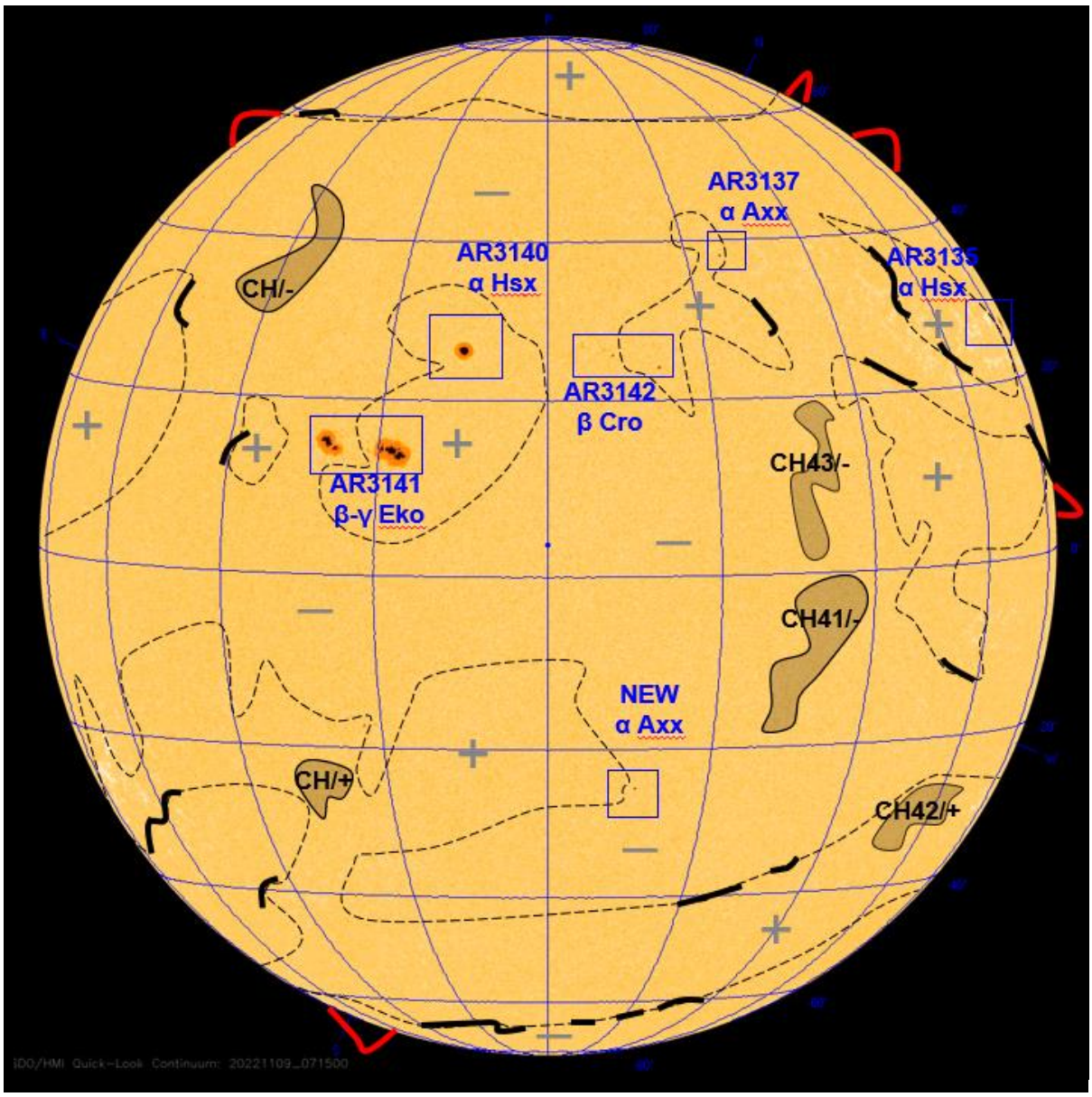
(greater than 2MeV) is expected to be at background to moderate levels for much of the period, possibly increasing to high levels at times of diurnal maxima. Electron fluence values expected to remain below the Active (1e8 integrated pfu) threshold, but with a probable slow overall rising trend.

Figure 1. Solar Analysis Valid 09/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth directed CMEs currently feature in the forecast. A number of filaments are present on the Earth-facing disc and will be monitored for any potential lift-offs.

Solar wind speeds are currently slow-ambient, around 370km/s. Influence from the elongated Coronal hole 42 in the south of the disk may see an increase in speeds at times, although there is low confidence in the strength of any connection. Indeed STEREO A has not apparently observed any connection to this feature so far. There is a greater likelihood that Earth may connect to coronal holes 41 or 43 later on day 1 (9th) or most likely into day 2 (10th). However any impact at the Earth is expected to be fairly limited due to their negative polarity as we slowly edge away from the autumn equinox.

Geomagnetic activity is expected to be mainly Quiet to Unsettled, with a chance of Active intervals at times given any prolonged periods of negative Bz and approaching coronal hole high speed streams. There is a very slight chance of G1/Minor Storm intervals from the possible arrival of coronal hole high speed streams during days 1 and 2 (9th and 10th). Becoming mostly Quiet to Unsettled by days 3 and 4 (11th and 12th).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	10	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

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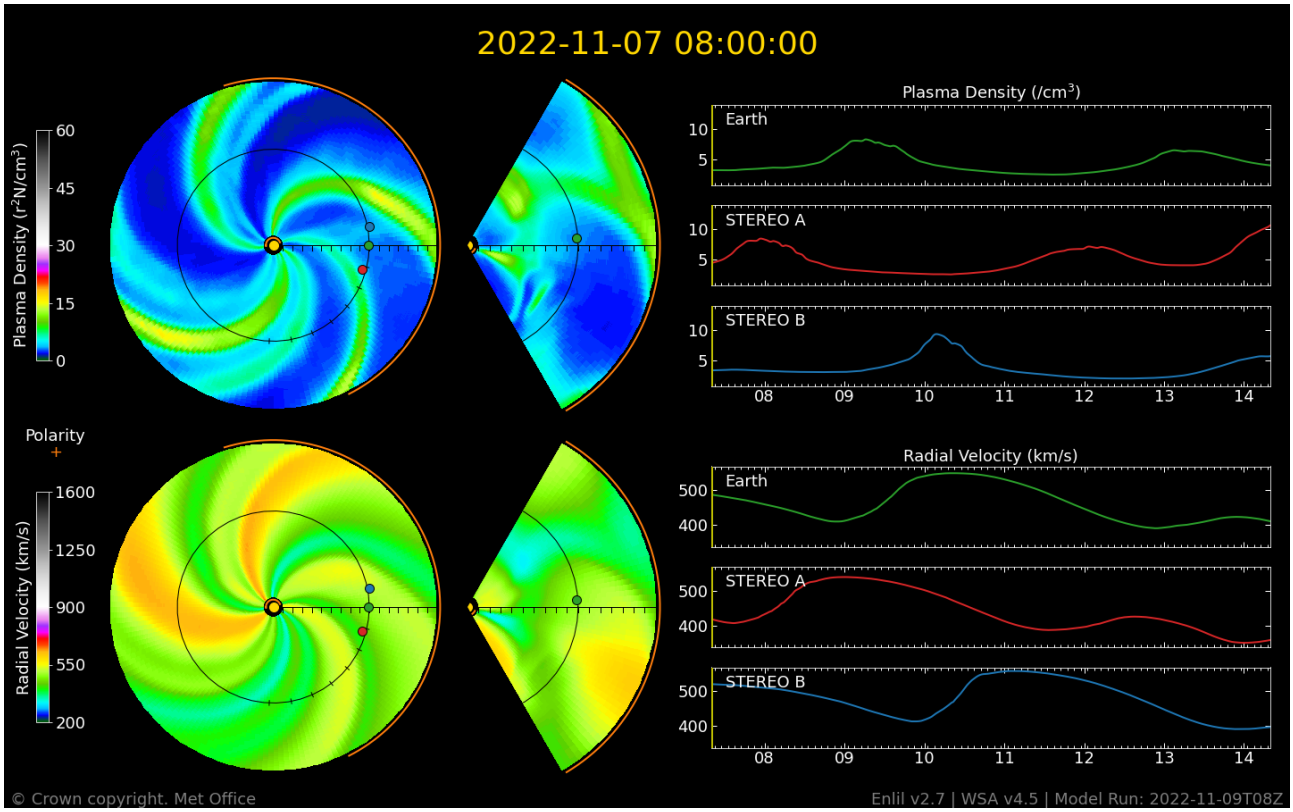
Figure 2: MOSWOC ENLIL showing arrival of fast wind from coronal holes 41 and 43 late 9th into the 10th Nov.



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Radio Blackouts - X-Ray Flares:

There are currently five numbered sunspot regions and one unnumbered group on the visible disc. AR3141 in the east remains the largest, most active and complex group, classified as Eko/Beta-gamma but showing little overall change since the last analysis. AR3140 is the second largest region, with a moderately sized mature spot, Hsx/Alpha, though the region remains largely inactive. The only other moderately sized unipolar spot remains AR3135, a Hsx/Alpha, now very close to the northwest limb. Other spots are small and relatively simple.

STEREO-A EUVI imagery suggests a new bright flux region will rotate over the southeast limb on day 1 (9th). This area may contain one or more sunspot groups that could supplement the present risk of significant flares. Additionally two Strong Active Regions (SARs) recognised in the far hemisphere by the Strong Active Region Discriminator (SARD), are expected to reach the east limb over the next 24 hours. This also may increase the risk for significant flares into day 2 (10th).

Solar activity has been Low, with only one significant C-class flare observed in the past 24 hours, from AR3141. Activity is expected to remain largely Low, but there is a chance throughout of isolated M-class flares, most likely from AR3141, giving Moderate solar activity.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	20	25	30	30
Very Active	R3 to R5 X Class	No	5	5	5	5

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Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (greater than 10 MeV) at GEO, observed by GOES-16 is currently at background levels and is forecast to generally remain at this level through the period. A very minor increase in proton storm probabilities is included towards day 4 (12th) as AR3141 moves into a more effective position relative to Earth.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	2	5
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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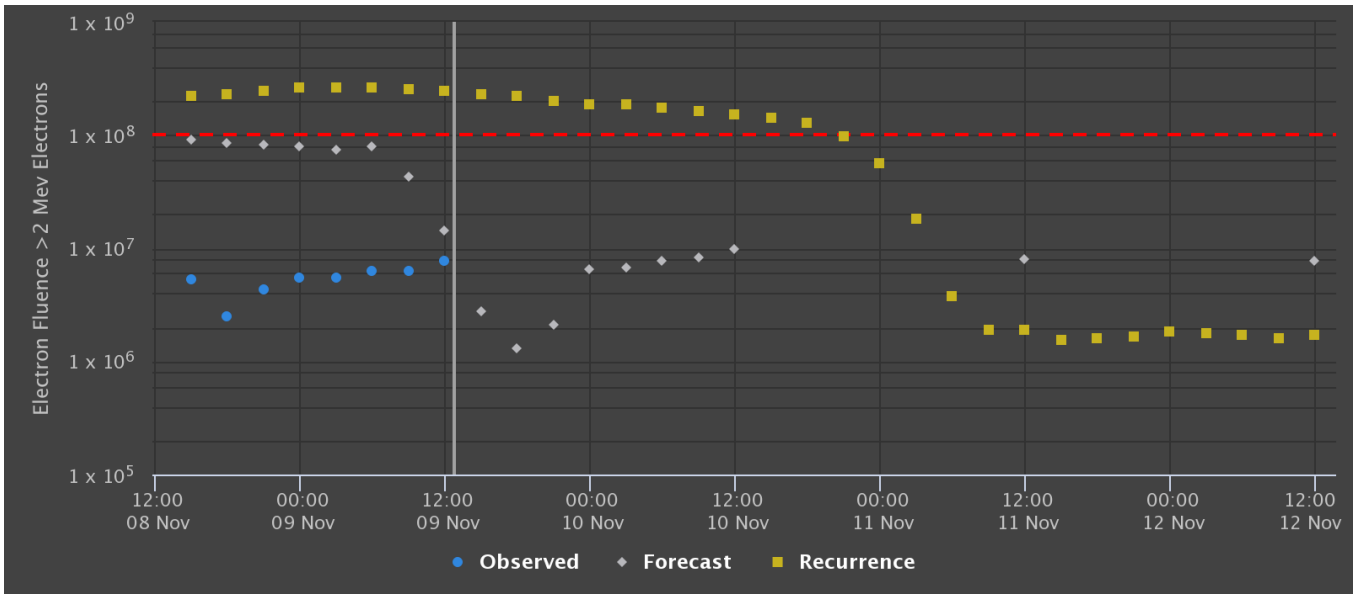
High Energy Electrons Event (≥ 2MeV):
The high energy electron flux (greater than 2 MeV) at GOES-16 was at background to moderate levels during the past 24 hours, with a peak of 365 pfu at 08/1700 UTC. Background to moderate levels are now expected to be maintained for much of the period, possibly increasing to high levels at diurnal maxima.

Electron fluence levels are now well below the Active threshold. Confidence in the forecast is high initially. This lowers to moderate by the end of the period given uncertainties over the duration and strength of any geomagnetic activity resulting from one or more forecast high speed streams that are due to affect Earth.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	5	5	10	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: REFM electron fluence.



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